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RESONANCE OF THE EARTH-IONOSPHERE CAVITY: DIFFERENCE BETWEEN THE DIURNAL VARIATIONS OF TWO ORTHOGONAL MAGNETIC COMPONENTS *

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by Jean Etcheto
& Jacqueline Sterne

The ascertaining of the diurnal variation of the amplitude of Earth-ionosphere cavity's fundamental mode of resonance was already made by the study of the electric, or of a magnetic component of the terrestrial field [1, 2]. This diurnal variation could be interpreted as a consequence of the evolution of thunderstorm seat distribution on Earth in the course of the day. However, the measurements do not allow to define the source's azimuth.

In order to achieve this, we registered simultaneously the variation of the two magnetic components, East-West and North-South, during six weeks at the Observatory of Chambon-la Forêt.

REGISTRATION.- The method of measurement is similar to that applied by Gendrin and Stefant [1]. Each track includes a set of three ferrite probes of 2 000 spires each, placed in series, an integrating amplifier and a magnetic recorder Sareg. This recorder allows the simultaneous utilization of four paths. The speed of passage is 0.59 cm/sec. The 1100 meter long bands assure a continuous registration for 48 hours. The information registered on each track consists of : the two components of the field, a reference signal at 8 cps and hourly signals.

The pass band of each track ranges from 5 to 25 cps at ±1 dB.

* Résonance de la cavité Terre-ionosphere : Différence entre les variations diurnes des deux composantes magnétiques orthogonales.

<u>Calibration</u>.- The calibration system is similar to that described in reference [1], with the difference, however, that each coil consists of four findings.

Four quartz-stabilized calibration frequencies, distributed inside the pass-band (6, 12, 16 and 24 cps), can thus be simultaneously dispatched. Four levels (0.1, 0.2, 0.3 and 0.4 efficient mγ) are successively utilized during 15 min. each.

Analysis of these calibrations on sonograph provides information on the gain of each channel, the sensitivity, the pass-band and gives frequency-accurate reference points.

The equipments of the two channels are identical and entirely separate so as to avoid any possible parasitic coupling of the two components.

An intermodulation test of the two channels was carried out by dispatching a very strong calibration signal (160 mγ eff.) on one of the channels. Analysis of the spectrum on the other channel did not allow to detect this signal.

<u>Processing</u>.- The reading magnetophone, running at 76 cm/sec, affects the registered frequencies by a factor of 128. A sharp -cutoff L.I.E. filter at each channel ($\pm$ 0.5 dB from 940 to 1080 cps and $-$ 60 dB at 900 and 1100 cps) allows the retaining only of frequencies between 7.5 and 8.5 cps reals.

At filter output, a linear detection delivers a continuous variable voltage, registered on a spot tracker recorder. We thus assure a continuous registration of the integrated intensity, profiting from a very great analysis rapidity (25 mm per 48 hour period).

Alongside with this, the sorting of sonograph calibrations, modified so as to obtain the curve of spectral density [1, 3], permit awareness of the ponderation factor, of which the curves may have to be eventually affected in case of variation of characteristics' series and to obtain an absolute value of signal intensity.

Time Markings.- We register a frequency of 80 cps, interrupted every 15 minutes. At reading, the detected signal sets the proper device(?) of the spot tracker in motion.

Results.— An example of registration (Fig.1) shows the variation of fundamental's intensity. We note :

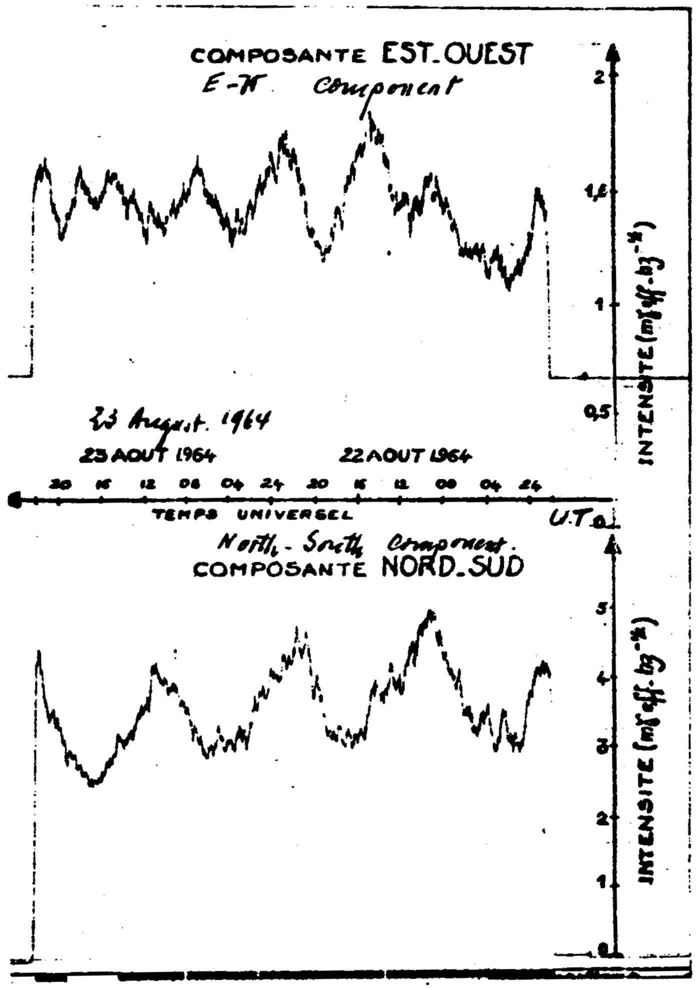

Fig.1. - Example of automatic registration of the amplitude's diurnal variations of two orthogonal components.

1) that the NS component shows two daily maxima toward 09 00 and 22 00 hours U.T., result analogous to that obtained by Stefant in the course of the summer of 1962. (see [3]

2) that the EW-component, which is weaker, shows three daily maxima. Two of these (morning and night) correspond approximately to those of the NS-component, while the the third, at about 1500 hours U.T., takes place while a minimum, sharply outlined, appears on the orthogonal component. These results are rendered more significant by the calculation of averages for 10 days of registration. The calculation was effected after raising the amplitude taken on the graph by powers of 2. Thus we obtain the variation in power (Fig. 2). The zero of the scale is beset with an important uncertainty due to device's own noise, which has not heretofore been measured.

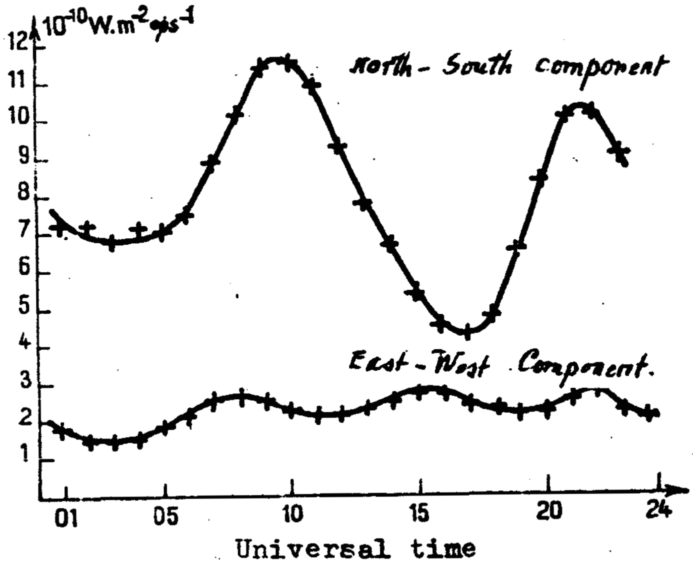

Fig. 2. - Mean diurnal variation of the fundamental for the period from 19 to 29 August 1964.

<u>Interpretation</u>.- The Earth-ionosphere cavity is excited by lightning. The principal thunderstorm seats move in the course of the day and develop mainly in equatorial regions of Asia, Africa and America.

The field radiated in the cavity by a lightning stroke is composed of a radial electrical vector and of a magnetic vector H, which is tangential and perpendicular to the line "source-observer" [4].- Depending upon the latter's azimuth, H will either have an EW or NS component, or not.

In case of Asian or American thunderstorms, the two components have about the same intensity. But it is no longer so for the thunderstorms taking place in Africa, for which the vector H, having the direction EW gives no signal on the NS probe. These thuderstorms usually take place at 16 00 hours local time, that is 15 hours U.T., and this provides the explanation for the existence of the third maximum observed on the E-W component.

It remains to explain why the intensity of this component is much lower than that of the N-S component, and to pursue this study on the other harmonics, the relative variation of their intensity being indeed instrumental in providing us, moreover, with information on the angular distance of the source.

*** THE END ***

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